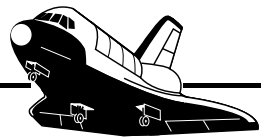




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Mission Highlights STS-44



Space Shuttle *Atlantis*

Nov. 24 - Dec. 1, 1991

Commander: Frederick D. Gregory, Col., USAF

Pilot: Terence T. Henricks, Col., USAF

Mission Specialists:

Story Musgrave, M.D.

James S. Voss, LTC., USA

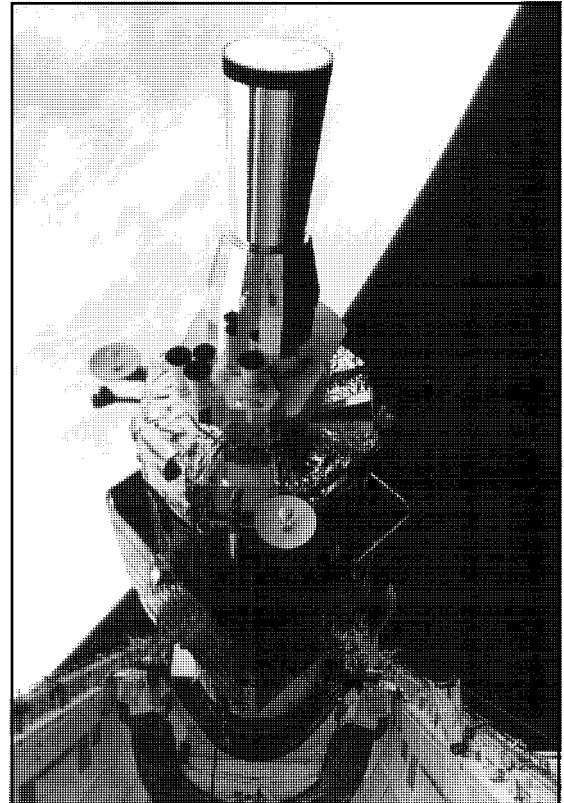
Mario Runco, Jr., LCDR., USN

Payload Specialist:

Thomas J. Hennen, CW3, USA

Major Mission Accomplishments

- Deployed a Defense Support Program satellite that will join a network of early warning satellites in detecting missile and space launches and nuclear detonations. (Department of Defense)
- Conducted the Terra Scout and the M88-1 experiments to investigate the human/machine interface between skilled remote-sensing technicians and current and advanced sensors and to assess what humans can see and communicate from space. (Department of Defense)
- Conducted extensive observations of atmospheric, oceanographic, geologic, and environmental phenomena, including daily observations of the development and dissipation of Typhoon Yuri, to enhance documentation and



Preparing the Defense Support Program satellite for release.

- understanding of the mechanisms at work on planet Earth.
- Conducted a series of medical investigations on crew performance in space and evaluated procedures to enhance crew ability to readjust to gravity upon return to Earth.
- Evaluated the Bioreactor Flow and Particle Trajectory experiment as a way of growing cell cultures on Space Station *Freedom*. (Johnson Space Center)
- Observed the Soviet *Mir* space station and exchanged messages.
- Established a new record for the most hours flown on Space Shuttle missions (Story Musgrave, 596 hours).

The successful deployment of the 2,364 kilogram Defense Support Program (DSP) satellite was the first of many achievements of the STS-44 mission crew. The DSP satellite was deployed six hours after the Space Shuttle *Atlantis* reached orbit. The satellite was raised on a tilting platform and ejected from *Atlantis*'s payload bay. One hour later, an Inertial Upper Stage (IUS) rocket booster fired and propelled the satellite into a geosynchronous orbit, where it will become a part of an early warning system to detect space and missile launches and nuclear detonations. DSP satellites have been serving America's defense needs for 20 years. The DSP deployed by *Atlantis* was a fifth generation satellite with improved sensor capabilities and a design lifetime of three years. Most satellites of this type, however, have lasted over five years.

During the remainder of the mission, crew members conducted a variety of activities: military-related Earth observation experiments, medical studies seeking to improve crew readjustment to gravity's effects upon return to Earth, radiation measurements, Earth-resources



STS-44 Crew Portrait: Frederick D. Gregory (right center). Clockwise from Gregory, Thomas J. Hennen, James S. Voss, Mario Runco, Jr., Story Musgrave, and Terence T. Henricks.

and meteorological observations, and evaluation of a new device for growing cell cultures. The M88-1 military observation experiment sought to assess human capabilities for visual identification of military facilities and activities on the ground. In spite of cloud interference, many observations were made over places such as the Patrick and MacDill Air Force bases. Several large ships, airplanes, and ground features were detected. In the Terra Scout investigation, the skills of a trained imagery analyst (payload specialist Tom Hennen) were used for investigation of the human/machine interface with current and advanced remote-sensing devices. This research will aid in the development of more powerful and versatile sensors.

A series of medical investigations was conducted to continue the development of measures to counter the physiological effects of spaceflight that astronauts experience upon return to Earth. Physical changes that take place in space include a shift of body fluids toward the upper torso and atrophy of some muscle fibers. Although these changes cause no problems during the flight, they do make readaptation to Earth more difficult. STS-44 crew members took turns wearing a collapsible Lower Body Negative Pressure (LBNP) device. The LBNP, which is like a sleeping bag, creates a negative pressure on the lower body of crew members and causes



Tom Henricks "rows" on a modified treadmill device for biomedical evaluation and exercise. Mario Runco, wearing biomedical sensors, awaits his turn.

body fluids to return temporarily to their normal prelaunch distributions. Evaluation of the device may lead to its regular use on extended duration missions lasting 13 to 16 days.

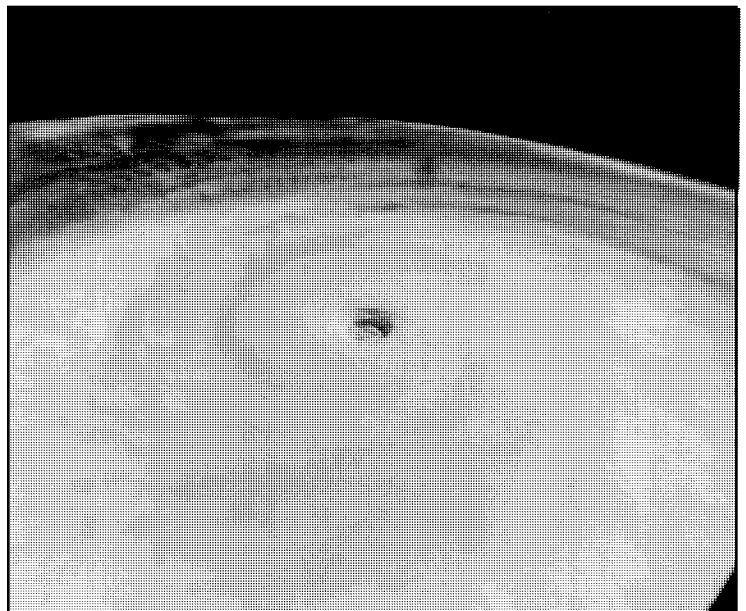
The STS-44 crew also conducted an experiment that could lead to the development of an important life sciences tool for use on Space Station *Freedom*. Crew members operated the Bioreactor Flow and Particle Trajectory experiment to validate and refine potential techniques for growing cell cultures in space. Typically, cell cultures are grown on Earth in flat dishes. Gravity limits and distorts the development of the cultures. The bioreactor will use microgravity to permit large cultures to be grown in three dimensions. Within the unit, two counterrotating drums circulate nutrients around cell cultures. In the STS-44 experiment, however, no cell cultures were grown. Instead, plastic beads of varying sizes were rotated in a solution of water and nutrients. The movements of the beads were studied to validate the predicted action of cell cultures in microgravity.

By a remarkable coincidence, the crew of the *Atlantis* found it necessary to maneuver in its orbit to avoid coming too close to a spent Soviet rocket that was launched in 1976. For the second time in the 31-year history of American manned space flight and the second consecutive Shuttle mission, a manned vehicle had to conduct such a maneuver. In another space encounter, the crew was able to obtain a good view of the Soviet *Mir* space station as *Atlantis*'s and *Mir*'s paths crossed within 40 kilometers of each other. On launch day, *Atlantis*'s liftoff was delayed a few minutes as the *Mir* crossed over Cape Canaveral, Florida. *Mir* commander Sergey Krikalyov relayed a congratulatory message to the *Atlantis* crew through amateur radio operators. The cosmonauts watched *Atlantis*'s entire launch sequence from orbit.

As with every Space Shuttle mission, observation of Earth resources was an important orbital activity. *Atlantis*'s crew made extensive observation of meteorological phenomena, land forms, and ocean-land interfaces. Catching everyone's attention was the development of Typhoon Yuri, an immense storm heading for Guam in the South Pacific. At *Atlantis*'s orbital speed of more than eight kilometers per second,

it took more than three minutes to cross over the storm. The crew took excellent pictures of the typhoon's eye. The shear walls of the eye were sometimes as much as 15 kilometers high. In the center of the eye, blue ocean was visible. Over several days, the crew observed the storm move northward and studied how the storm's energy diminished as it passed over colder waters. Other Earth observations included photography of sand dunes, Mt. Pinatubo in the Philippines, the Panama Canal, and stains from oil field fires around the city of Kuwait.

Atlantis was brought back to Earth three days early when a navigational unit failed. Inertial measurement units (IMU) provide information on attitude and acceleration that the orbiter's general



Typhoon Yuri over the north Pacific Ocean.

purpose computers use to operate the vehicle's control systems. *Atlantis*'s IMU began providing erroneous readings. *Atlantis* has three redundant IMUs, and the vehicle was in no danger. Nevertheless, flight controllers decided to bring *Atlantis* home early in accordance with mission flight rules, shortening a planned ten-day mission into seven. The early return was only the second time in 44 Space Shuttle flights that a vehicle was brought back sooner than planned because of equipment malfunction. In spite of the early return, the bulk of the mission's objectives had been accomplished at touchdown.

Mission Facts

Orbiter: *Atlantis*

Mission Dates: November 24 - December 1, 1991

Commander: Frederick D. Gregory, Col., USAF

Pilot: Terence T. Henricks, Col., USAF

Mission Specialists:

Story Musgrave, M.D. - Mission Specialist

James S. Voss, LTC., USA

Mario Runco, Jr., LCDR., USN

Payload Specialist:

Thomas J. Hennen, CW3, USA

Mission Duration: 6 days, 22 hours, 50 minutes

Kilometers Traveled: 4,650,984

Orbital Inclination: 28.45 degrees

Orbits of Earth: 110

Orbital Altitude: 361 km

Payload Weight Up: 20,240 kg

Orbiter Landing Weight: 87,919 kg

Landed: Runway 05, Edwards Air Force Base

Payloads and Experiments:

Defense Support Program/IUS

Interim Operational Contamination Monitor

Air Force Maui Optical Site

Cosmic Radiation Effects and Activation Monitor
M88-1

Radiation Monitoring Experiment

Terra Scout

Ultraviolet Plume Experiment

Visual Function Tester 1

Bioreactor Flow and Particle Trajectory

Twelve medical experiments



STS-44 Crew Patch

Crew Biographies

Frederick D. Gregory (Col., USAF) Frederick Gregory was born in Washington, D.C. He earned a Bachelor of Science degree from the United States Air Force Academy and a master's degree in information systems from George Washington University. Gregory served as a helicopter rescue pilot in Vietnam and later became a jet pilot and test pilot. He has flown in space as the pilot on the STS-51B/Spacelab-3 mission and as the commander on the STS-33 mission.

Terence T. "Tom" Henricks (Col., USAF) Tom Henricks was born in Bryan, Ohio but considers Woodville, Ohio, to be his hometown. He received a Bachelor of Science degree in civil engineering from the U.S. Air Force Academy in 1974 and a master's degree in public administration from Golden Gate University in 1982. Henricks has served as a test pilot. This was his first space flight.

James S. Voss (Lt. Col., USA) Jim Voss was born in Cordova, Alabama but considers Opelika, Alabama, to be his hometown. He earned a Bachelor of Science degree in aerospace engineering from Auburn University and a Master of Science degree in Aerospace engineering Sciences from the University of Colorado. Voss has served as an intelligence staff officer, company commander, and an Army flight test engineer. This was his first space flight.

Mario Runco, Jr. (LCDR., USN) Mario Runco was born in the Bronx, New York, but considers Yonkers, New York, to be his hometown. He earned a Bachelor of Science degree in meteorology and physical oceanography from the City College of New York and a Master of Science degree in meteorology from Rutgers University. Runco has been a research hydrologist, New Jersey State Trooper, U.S. Navy research meteorologist, and commanding officer of an oceanographic unit. This was his first space flight.

Story Musgrave (M.D.) Story Musgrave was born in Boston, Massachusetts, but considers Lexington, Kentucky, to be his hometown. He has earned six college degrees, in mathematics and statistics, business administration, chemistry, medicine, physiology and biophysics, and literature. Musgrave has earned U.S. Air Force wings and several FAA ratings. He was a backup science-pilot for the first Skylab mission and has flown in space three times, as a mission specialist on the STS-6, STS-51-F, and STS-33 missions.

Thomas J. Hennen, (Chief Warrant Officer 3, USA) Thomas Hennen was born in Albany, Georgia, but considers Columbus, Ohio, to be his hometown. He attended Urbana College and received extensive training from the U.S. Army in the field of image analysis. Hennen has more than 18 years of experience as an operational imagery analyst at both national and tactical intelligence levels. This was his first space flight.